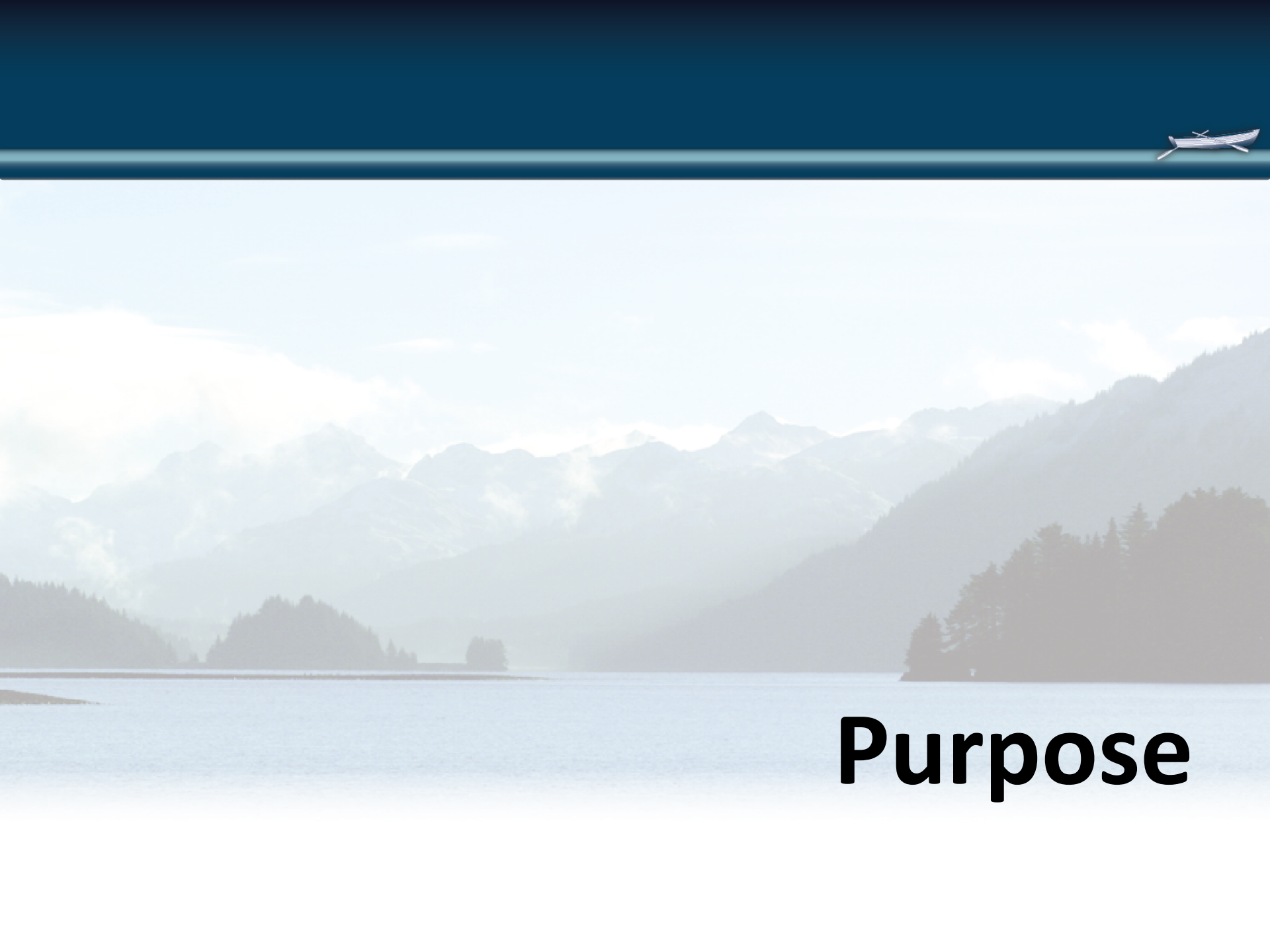
nuka Research & Planning Group, LLC.

December 6, 2018

Grays Harbor
Oil Spill Response Capacity Analysis



Purpose

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Purpose of the project:

- Better understand response system
- Analyze impact of potential enhancements/modifications
- **NOT FOR** Regulatory compliance

Purpose of the meeting:

- Introduce Nuka Research as contractor
- Ensure Harbor Safety Committee members understand the project and approach
- Get input on research questions, inputs and assumptions to be used in the analysis

Response Capacity Analysis Approach

Response Capacity Analysis

ca·pac·i·ty

the maximum amount that something can contain.

~~This is how much oil will be collected~~.

“This is the maximum potential oil that could be recovered with a response system under the conditions being studied.”

System capacity

A metric

not a prediction.

How does capacity change if we modify the system? Or due to factors beyond our control?

Horsepower analogy

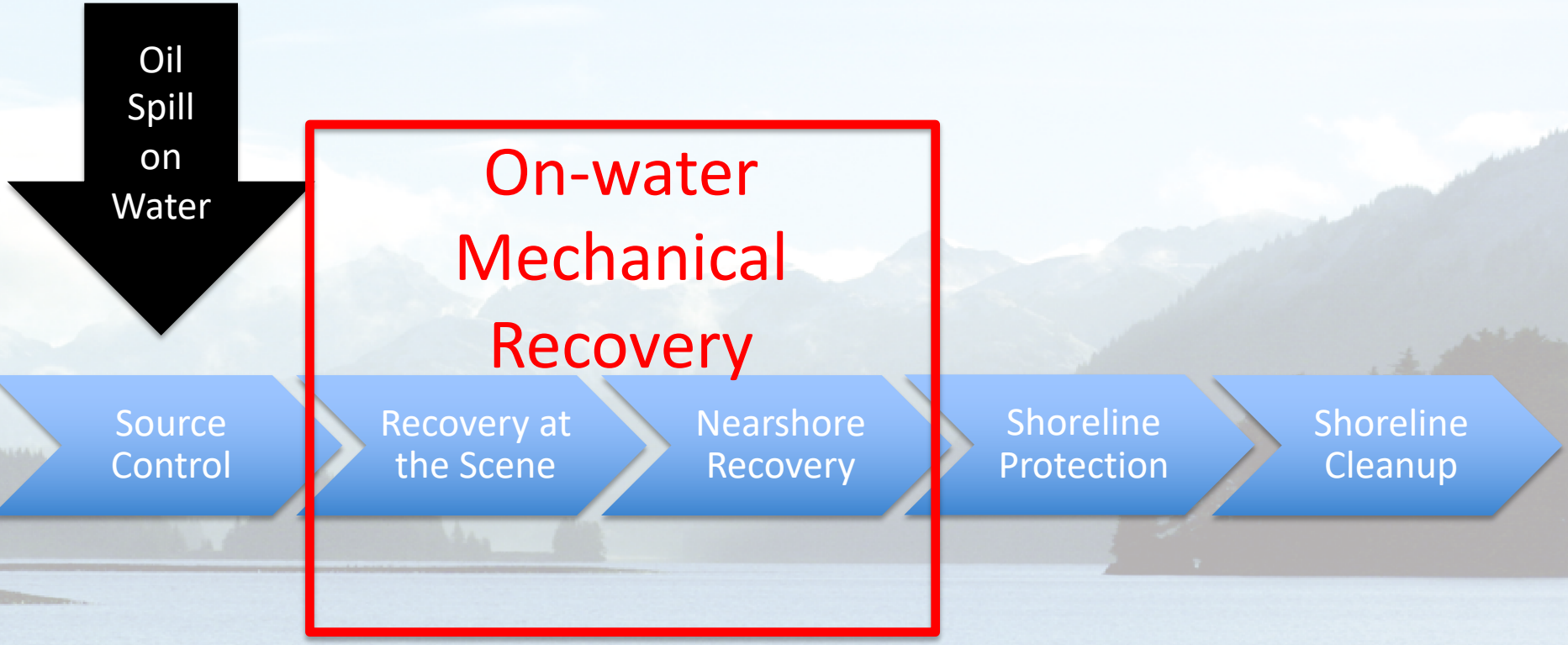
What is the horsepower of your car's engine?

You are unlikely to ever utilize 100% of that horsepower.

Technical Analysis

- How often could you respond?
  - Response Gap/Viability Analysis
- How much could you recover if you could respond, and what, if anything, could you do differently to increase this amount?
  - Response Capacity Analysis

Focus of RCA


Oil Spill on Water
On-water Mechanical Recovery
Source Control
Recovery at the Scene
Nearshore Recovery
Shoreline Protection
Shoreline Cleanup

Summary of Approach

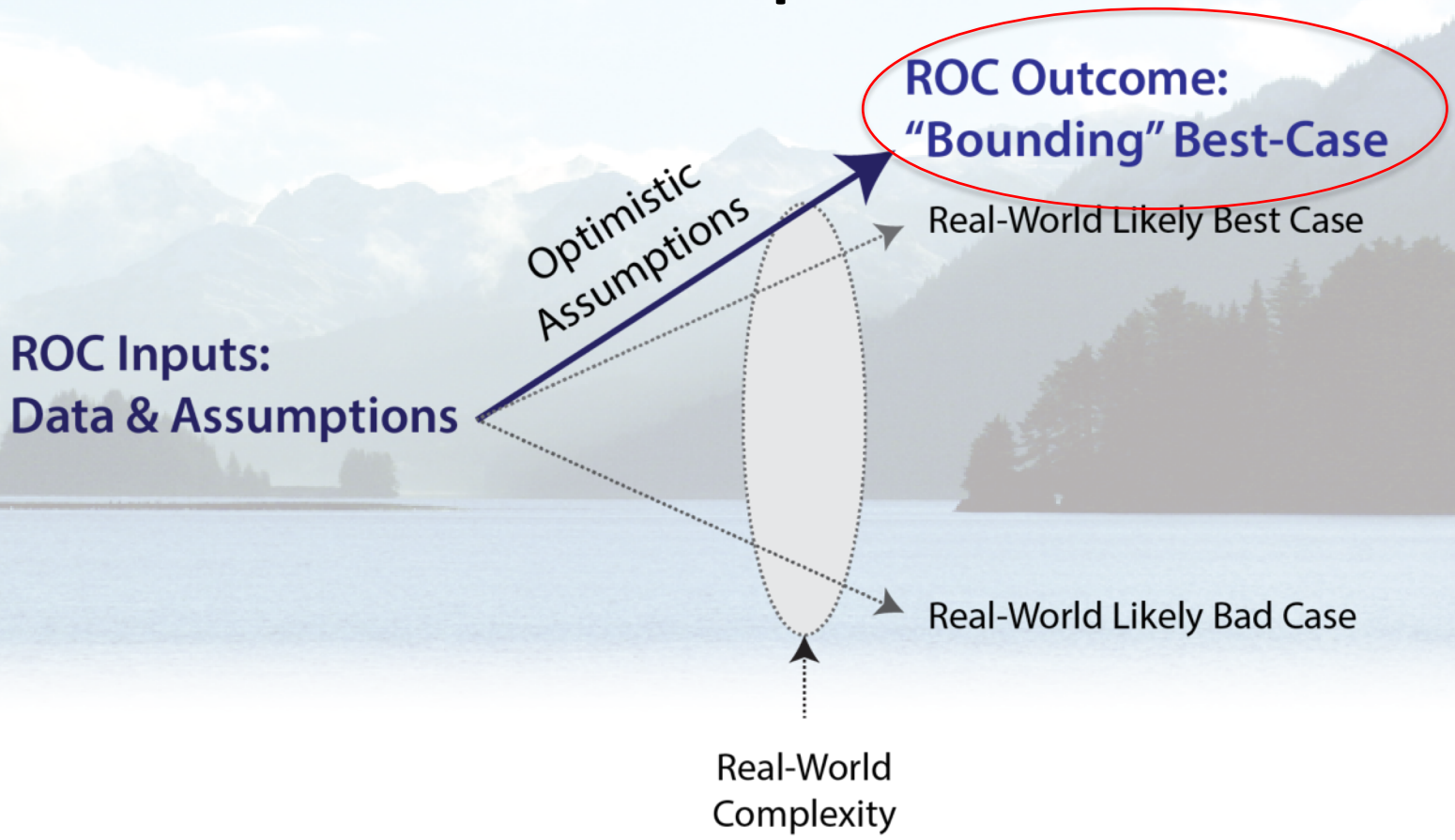
- Models a series of hypothetical spill responses by applying a defined set of response forces to spills under a range of conditions
  - ***Defined by RESEARCH QUESTIONS to be discussed today***
- Uses Response Options Calculator (ROC) to model capacity
  - ***Explained today***
- Provides estimates of potential oil recovery capacity
  - ***For comparison***

Things the RCA does not do:

1. Estimate how likely a spill is to happen.
2. Analyze whether conditions would or would not preclude a response.
3. Analyze the consequences to people and the environment if a spill happens.
4. Determine whether plan holders are in compliance with regulations.
5. Predict how much oil will be recovered if there is a spill.
6. Quantitatively analyze the effect of currents, tides, sinking oil, or stranding on oil spill response.

Considering Response Capacity

A model is one tool for considering what you might be able to do when in a response.



Response Options Calculator (ROC)

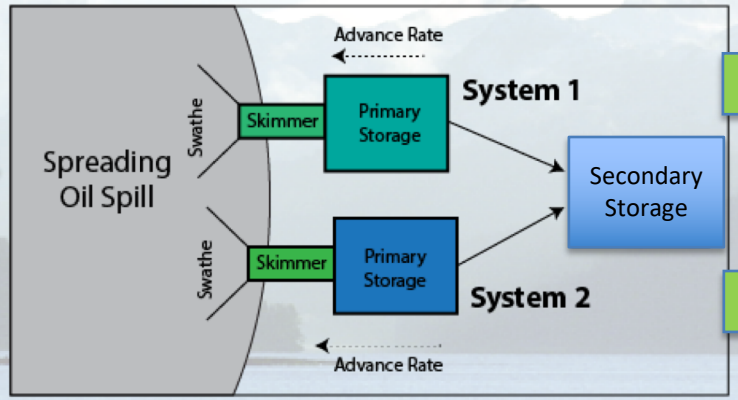
RCA Process

Inputs

Variables

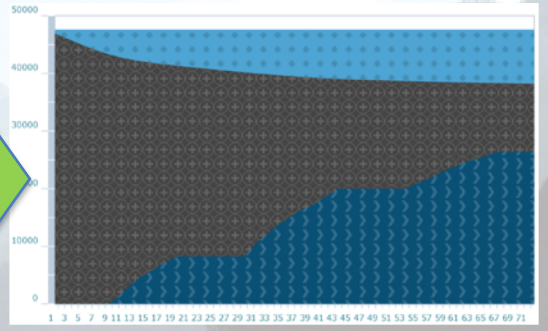
Temperature
Wind
Op Periods
Arrival Times
Swath Width
Skimmer Rate
Efficiency
Primary Storage
Barge Arrival
Decanting
Etc.

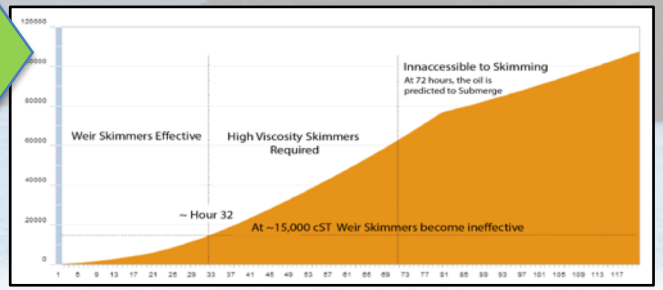
ROC Calculates



Outputs

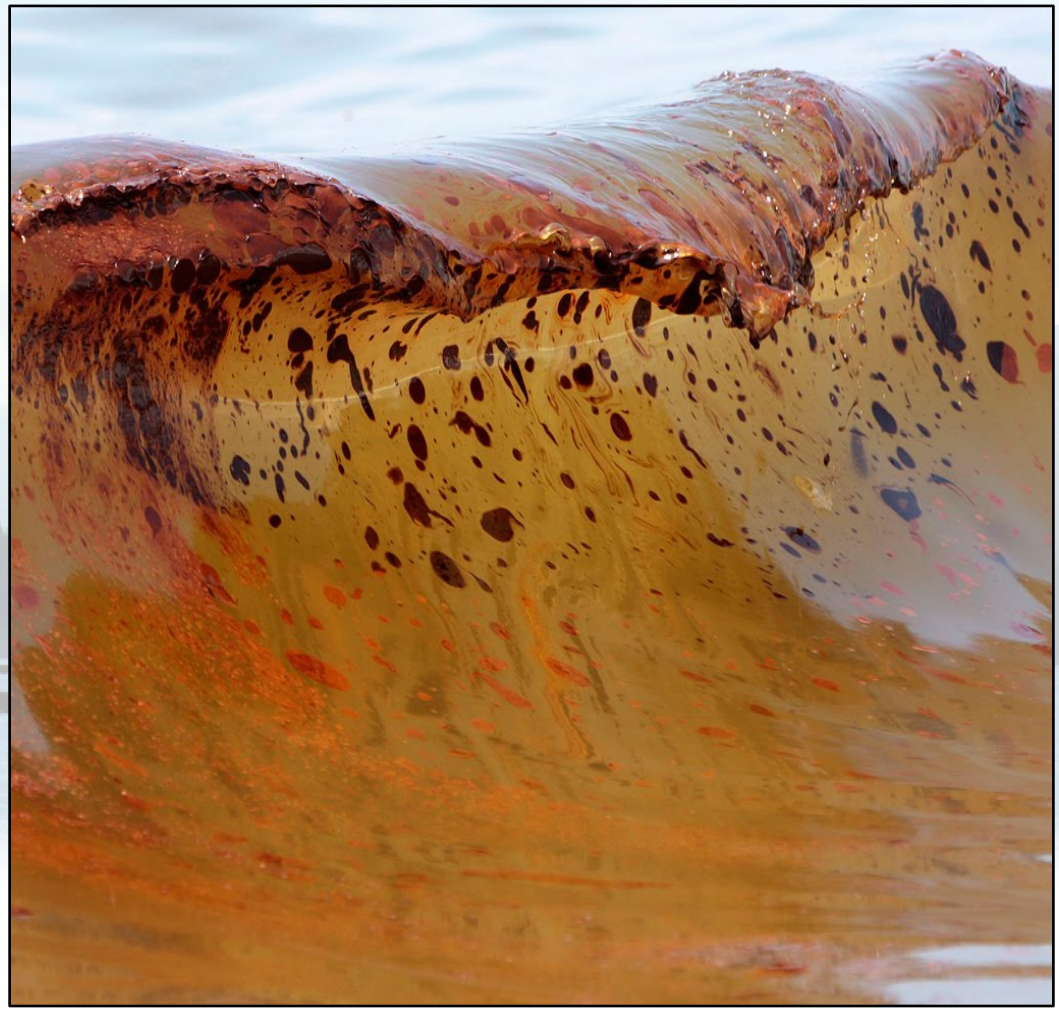
System Performance





Spill Behavior

Oil Weathering



Evaporation

Loss of Volatiles

Dispersion

Natural Dilution of Oil

Emulsion

Water Entrainment

Sedimentation

Picks up Particles & Debris

Oil Weathering Model

ROC uses the oil properties and the environmental conditions to predict the spreading and weathering of the oil slick. This is similar to the ADIOS model used by NOAA. The model predicts evaporation, natural dispersion, emulsification, viscosity, area, volume. It assumes uniform spreading. It DOES NOT predict sedimentation or submergence. It IS NOT a trajectory model.

Oil Recovery Model

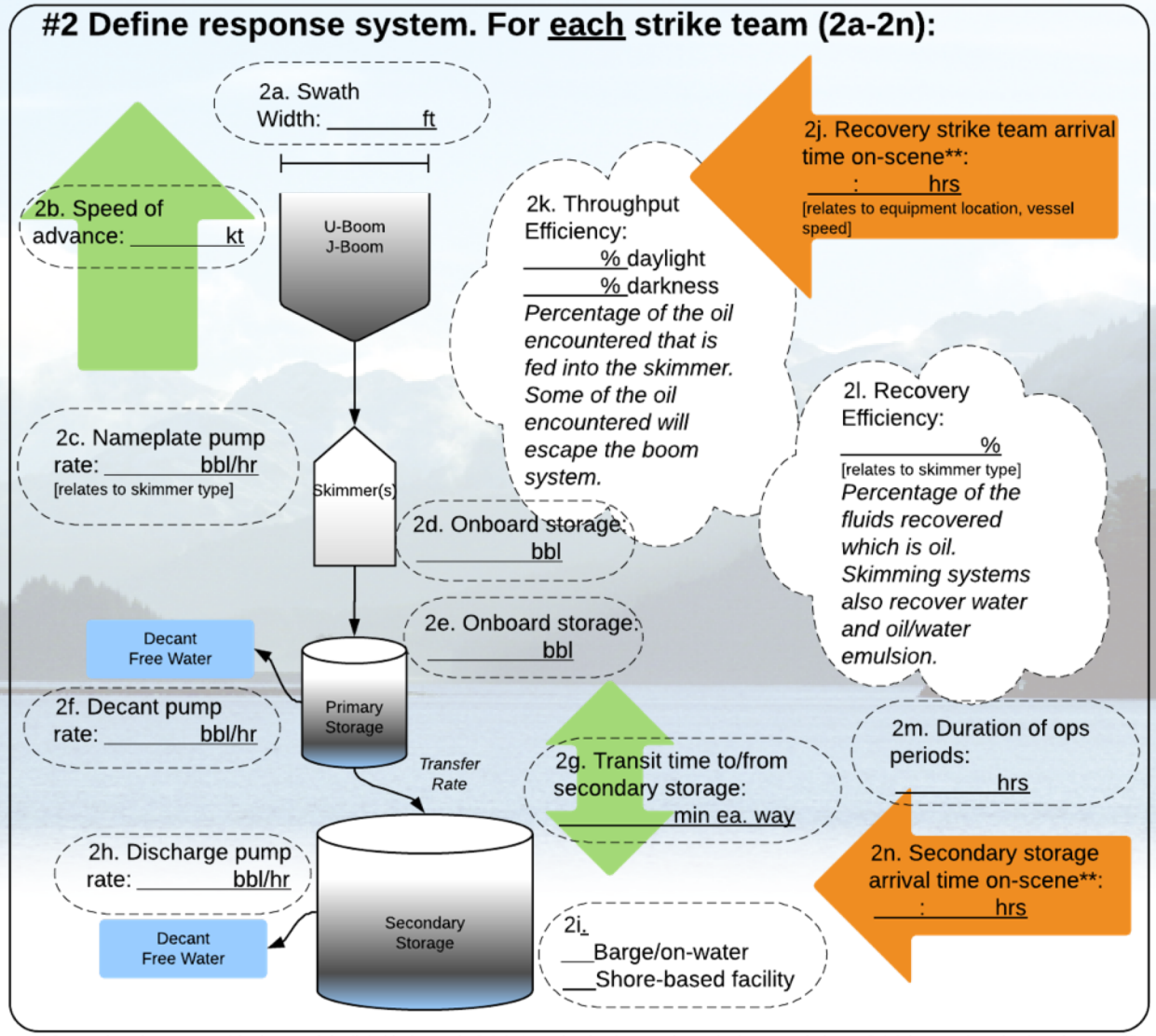
ROC utilizes processing engineering to calculate the encounter rate, and recovery of oil/water emulsion and free oil for each recovery system. It considers the availability of storage, decanting, and the transfer of recovered fluids to secondary storage. We consider the availability of secondary storage outside the model.

Inputs Oil Spill

#1 Establish the spill context.

a. Location*:_____.
b. Date*:_____.
c. Simulation start:___:____hrs
d. Duration of simulation (up to 5 days):___days
e. Instantaneous/continuous release?
f. Amount released:_____bbl
g. Oil type:_____.
h. Water temperature: _____F
i. Wind speed (static/variable):_____kt
j. Time to activate response: _____hr(s)
(Delays?:_____)
k. Night operations? Y/N

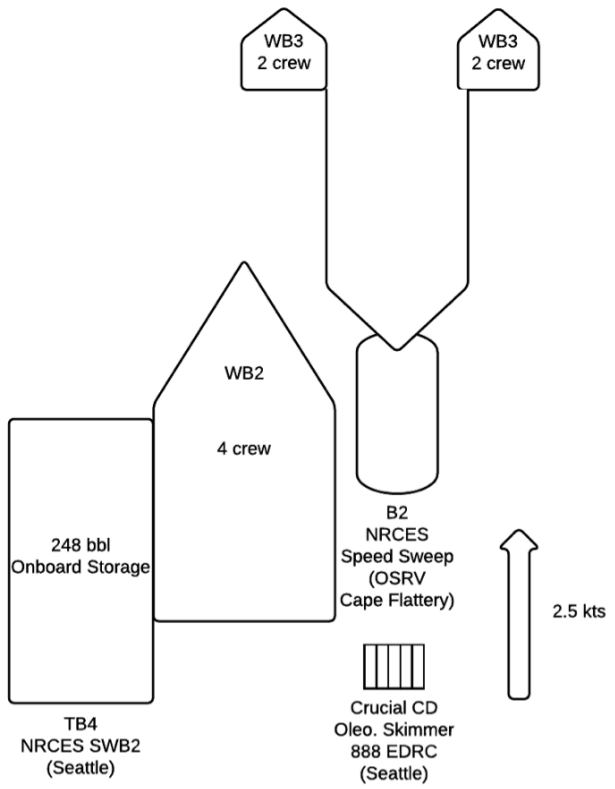
Inputs Response System



** Date + location are used for hours of daylight/darkness in ROC. Location is also used to calculate transit times. ROC is not otherwise location-specific.*
***Calculated outside of ROC, based on mobilization time + transit time (distance of primary equipment from spill site x speed) + on-scene set-up time*

Inputs Response System

Strike Team #22 (ST22)



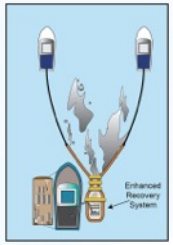
RESOURCES		
Type	*Identification*	*WRRLID*
B2	DESMI Speed Sweep	31492
SK2	Crucial CD	29795
TB4	SWB 2	30792
WB2	VOO, Valorous, 58' Neah	31519
WB3	NRC, FRV 5, 32', Bellingham	28569
WB3	NRC, FRV 9, 32' Everett	28572

INPUTS	
Skimmer Group	A
Skimming Speed (knots)	2.5
Swath Width (feet)	66
Onboard Storage (gal)	10,416
Nameplate Pump Rate (gpm)	138
Discharge Rate (gpm)	440
Decant Rate (gpm)	n/a
Offload Time (hh:mm)	1:24

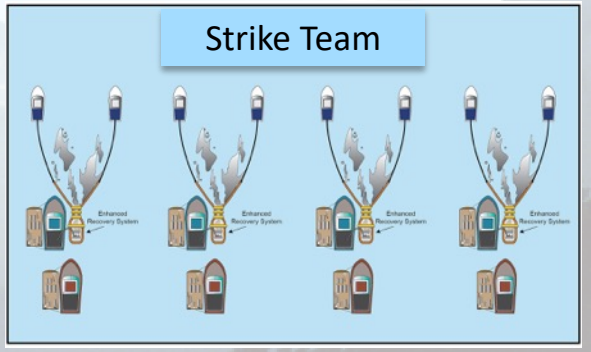
NOTES: Open Water
Skimmer and SWB can be trucked to Anacortes
Speed Sweep arrives on-scene on Cape Flattery

Build out of Response System

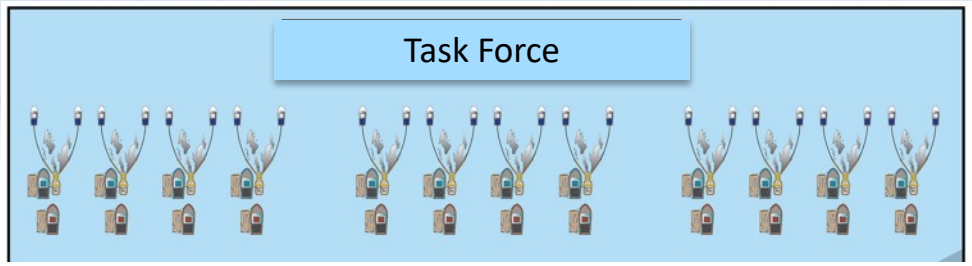
- Single Recovery System



- Strike Team



- Task Force



Basis for inputs

Oil Spill on Water

Response Sequence

Mechanical Recovery

Amateurs think tactics - Pros think logistics

Basis for inputs

Response Forces – Response System

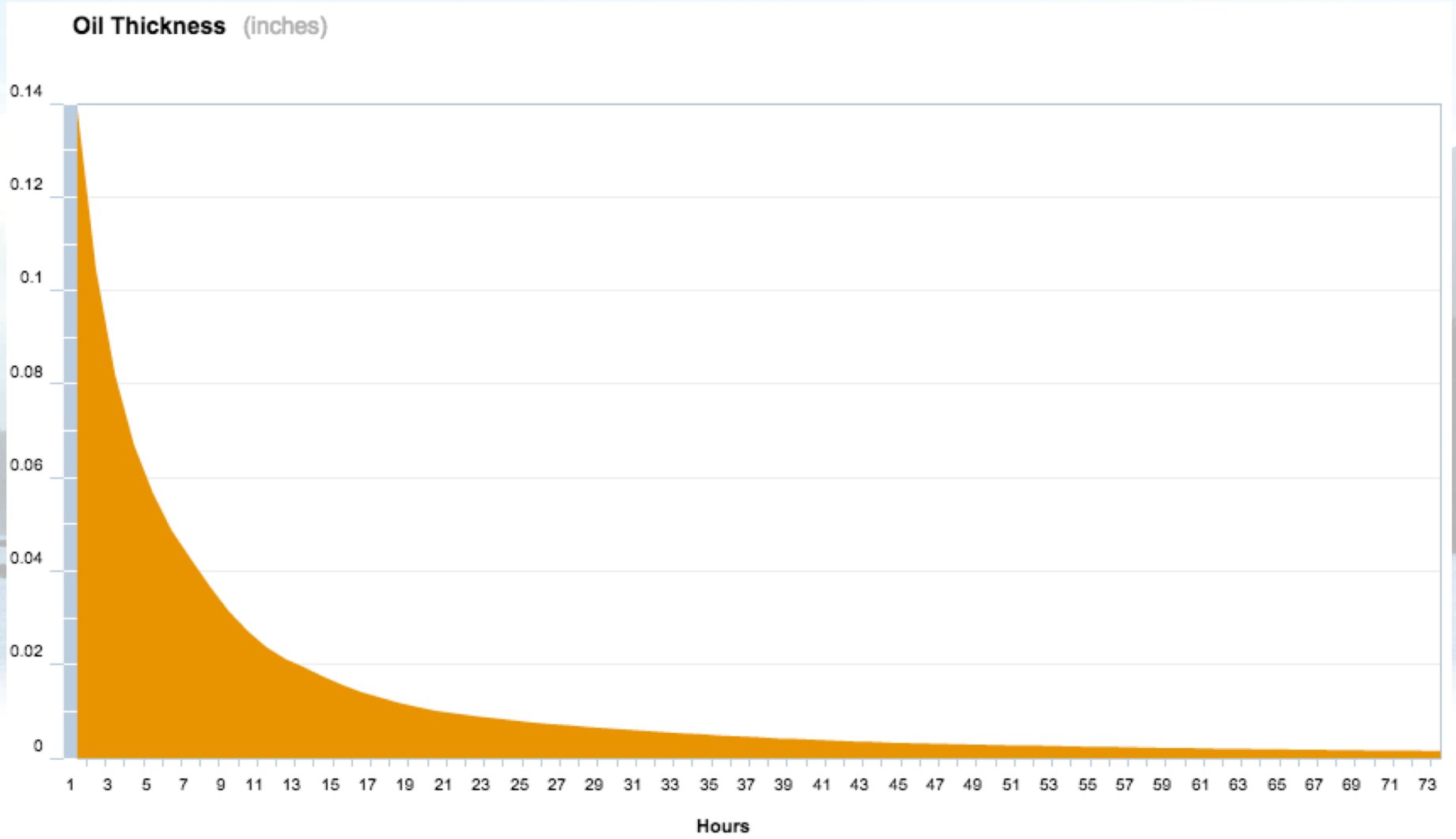
- Trained Responder
- Marine Vessel
- Boom
- Skimmer
- Primary Storage
- Secondary Storage

Strike Team – Task Force – Group – Division

What Can We Learn?

- After X Hours, estimated:
  - Oil recovered
  - Oil remaining on water
    - Thickness, viscosity, emulsion
  - Oil naturally dispersed or evaporated
- **Value is in the comparison**

Sample Outputs - Slick



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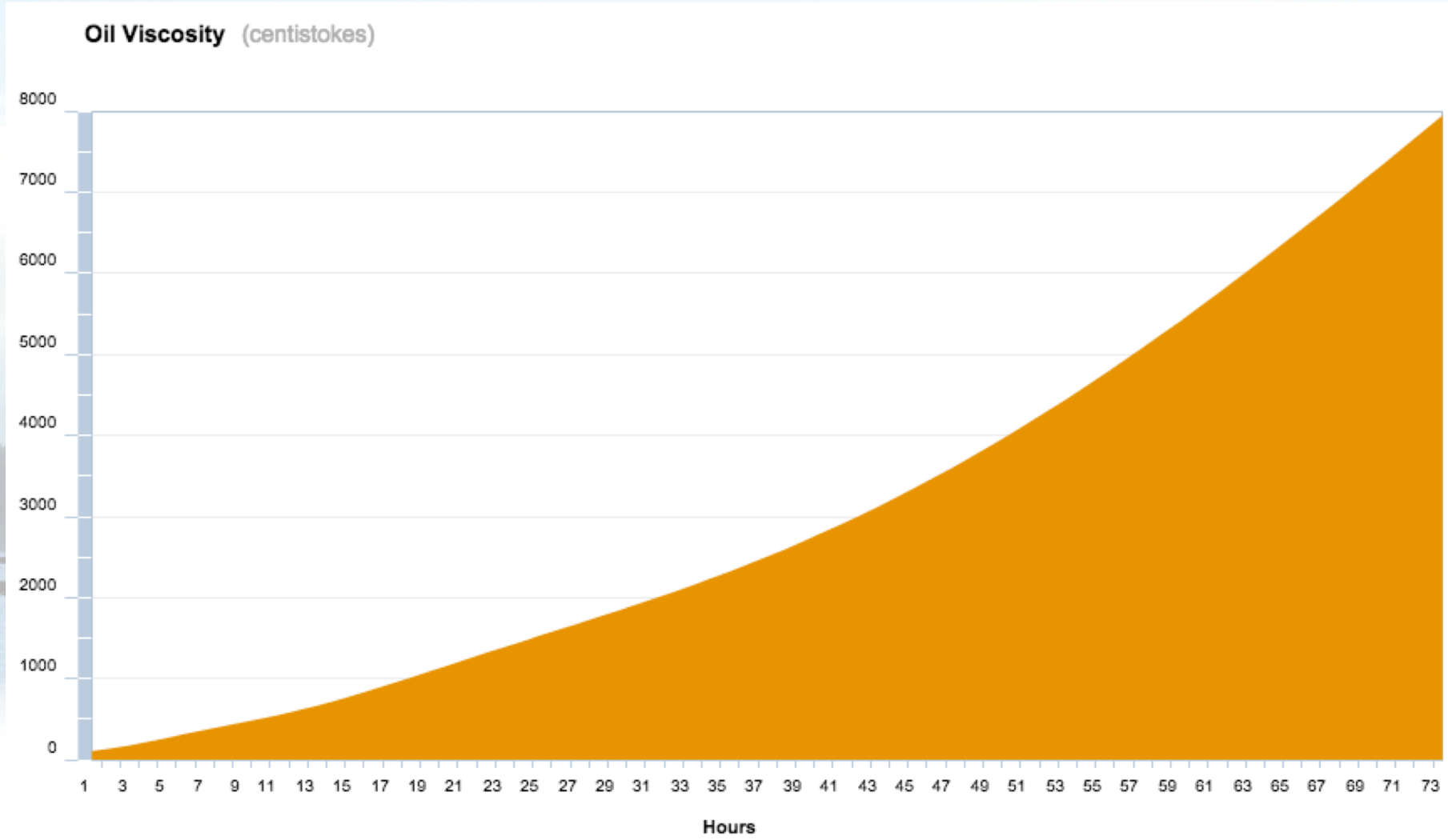

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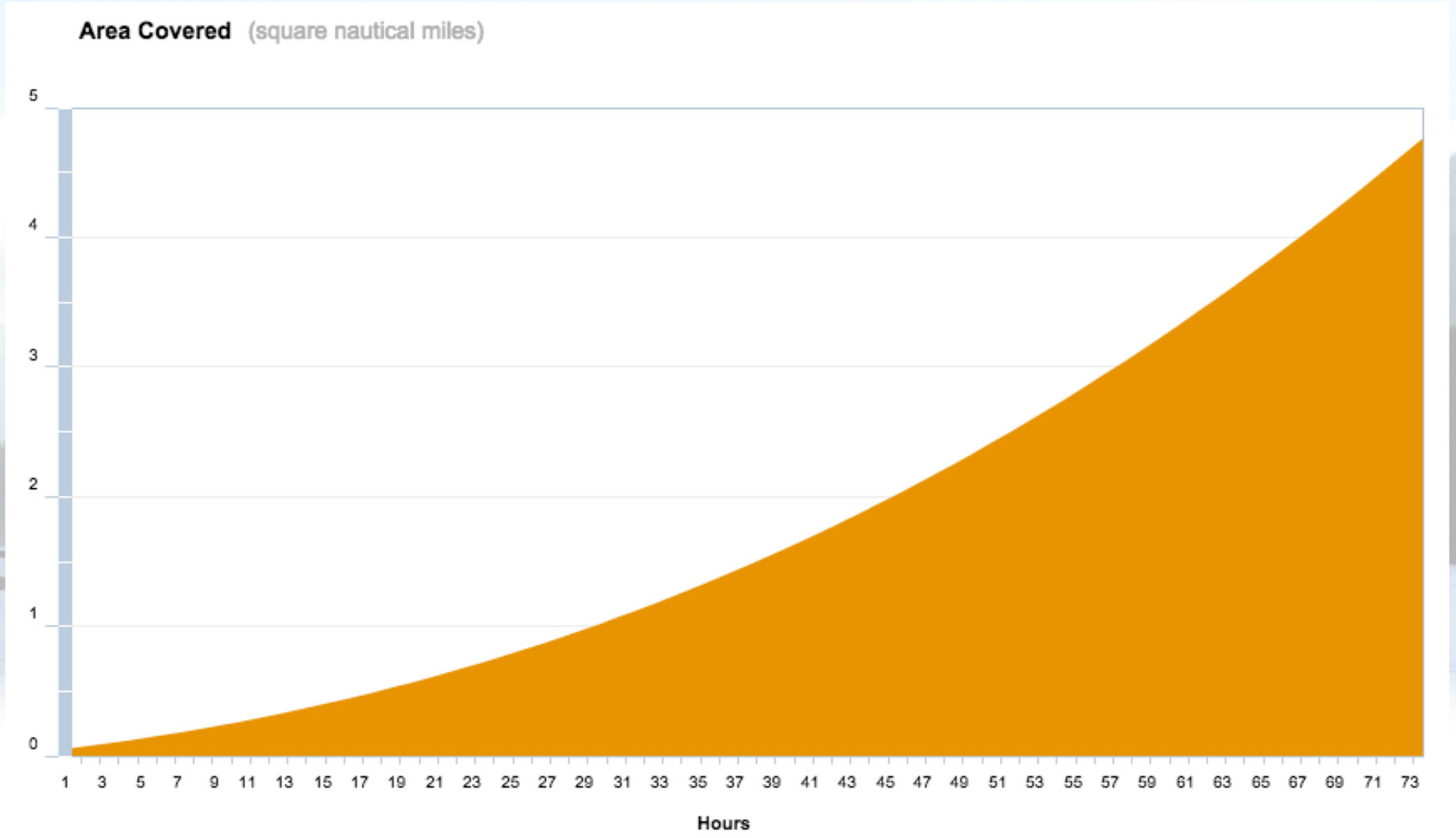
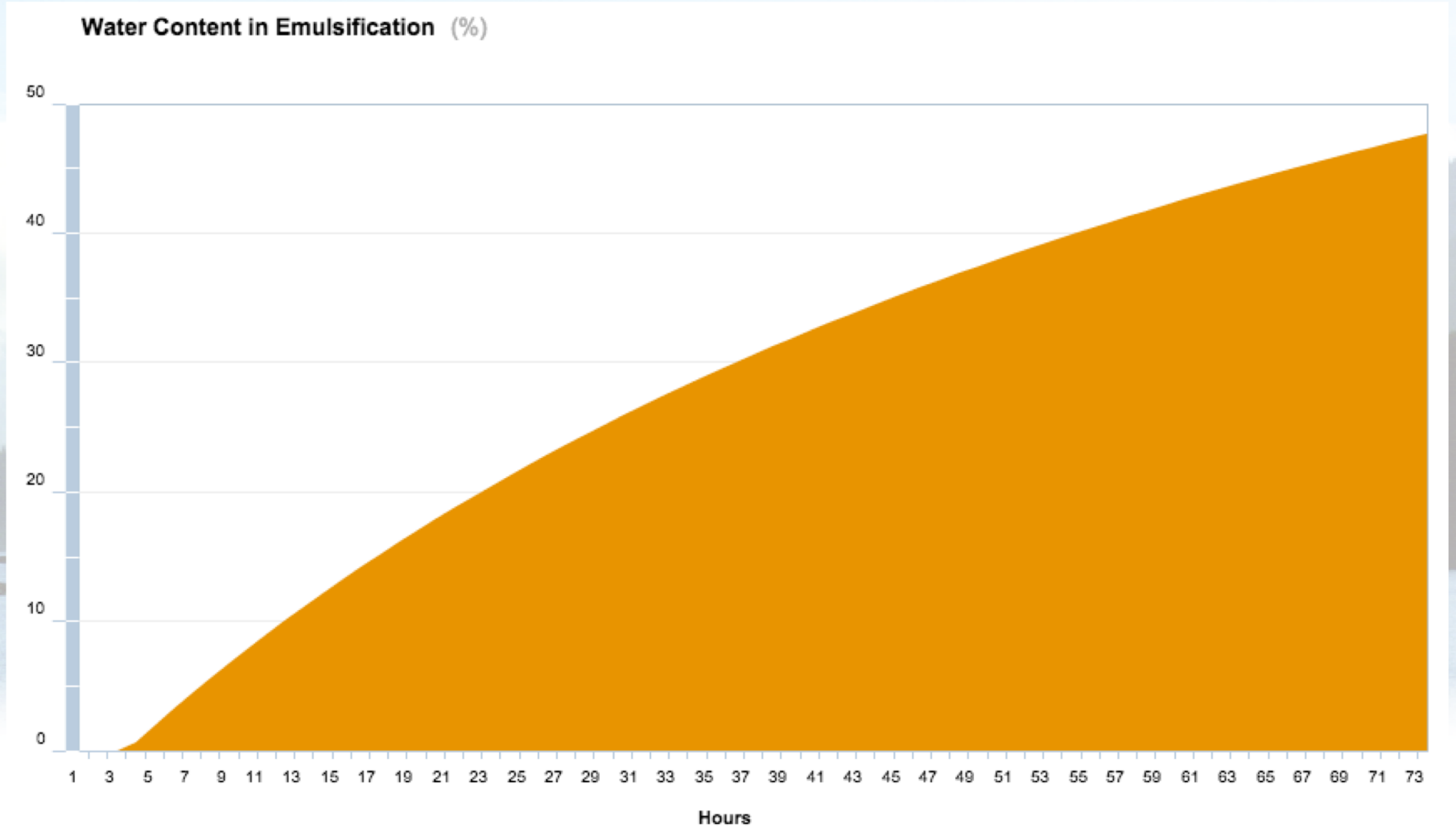
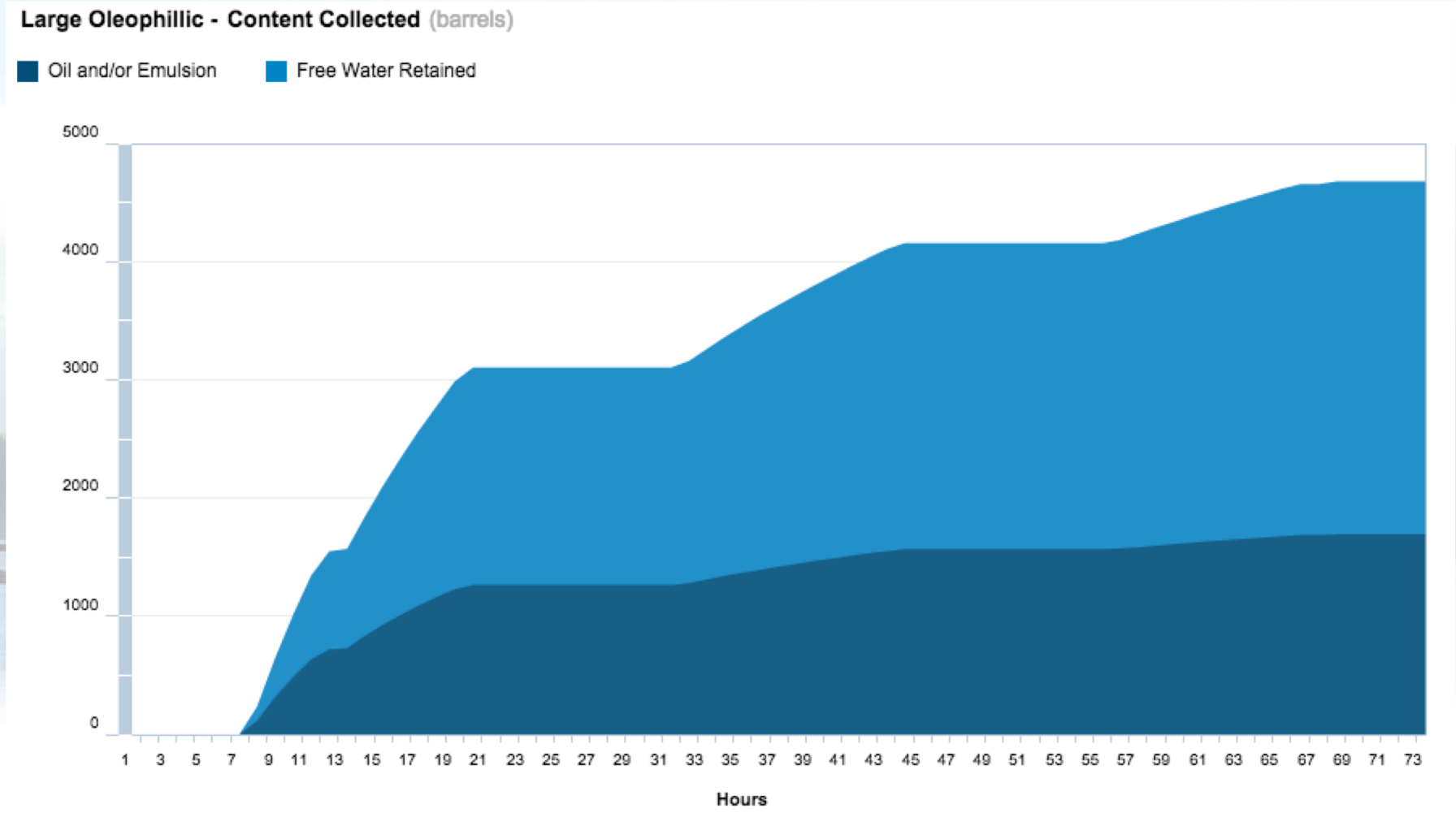


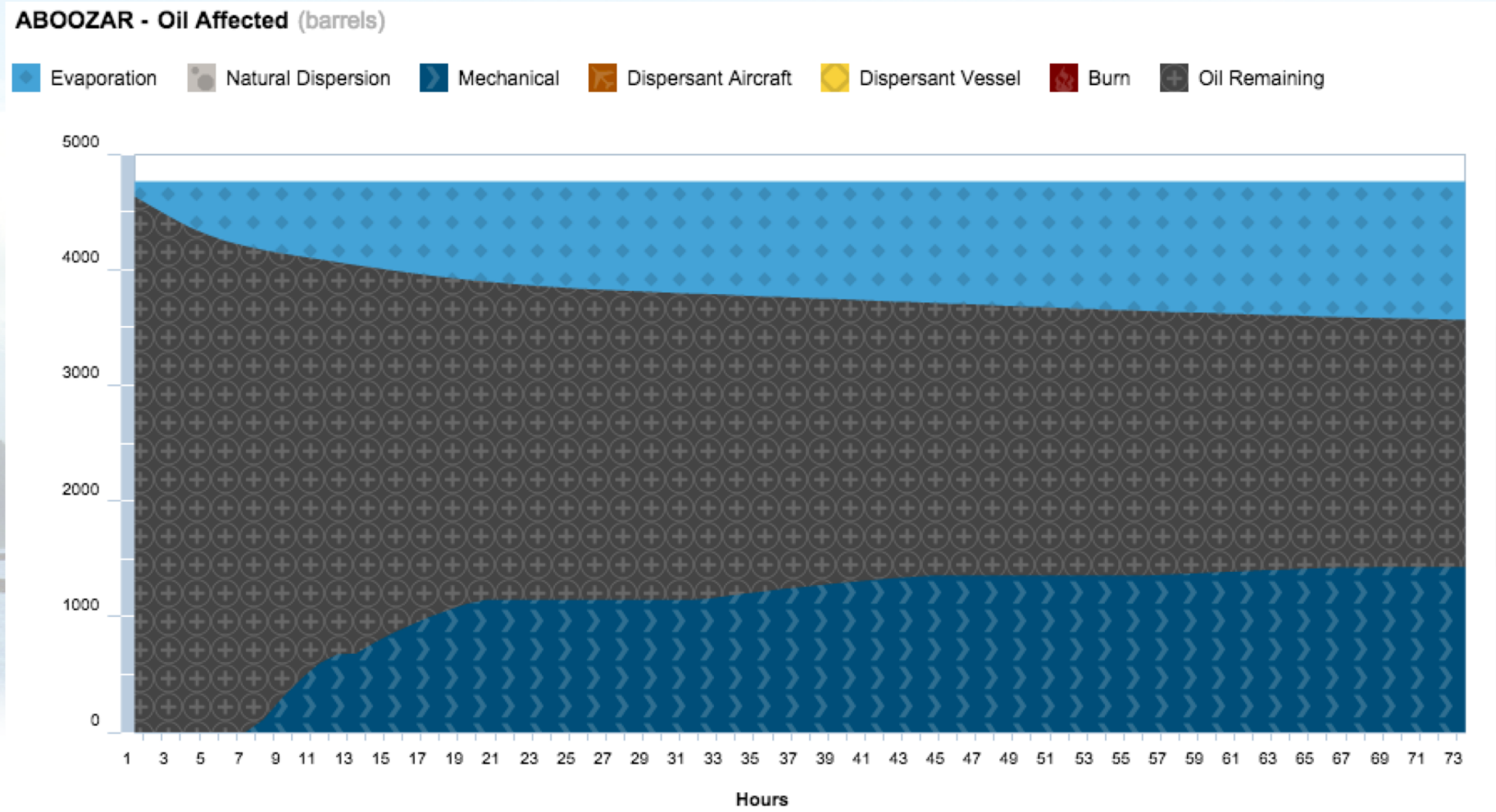
Sample Outputs - Slick

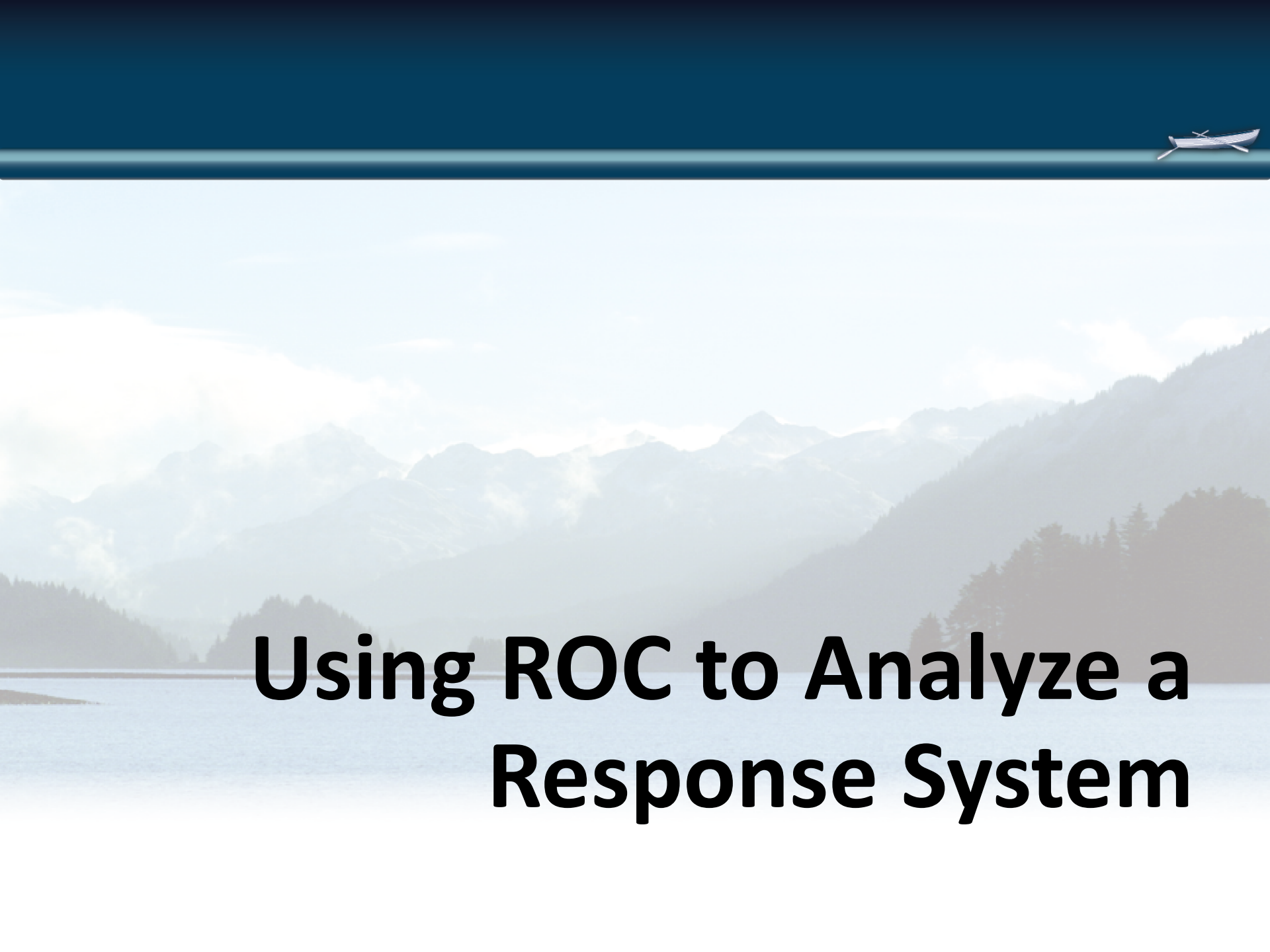


Sample Outputs - System



Sample Outputs – Mass Balance





Using ROC to Analyze a Response System

Establishing Research Questions

We can learn about the capacity, limitations, and variations of a response system using the ROC model if we take a systematic approach and focus on understanding the answer to a Research Question.

We suggest establishing a Base Case scenario for a spill and response system. Then using sensitivity analysis to examine the change in response capacity based on changing one or a limited number of variables in the base case.

Steps

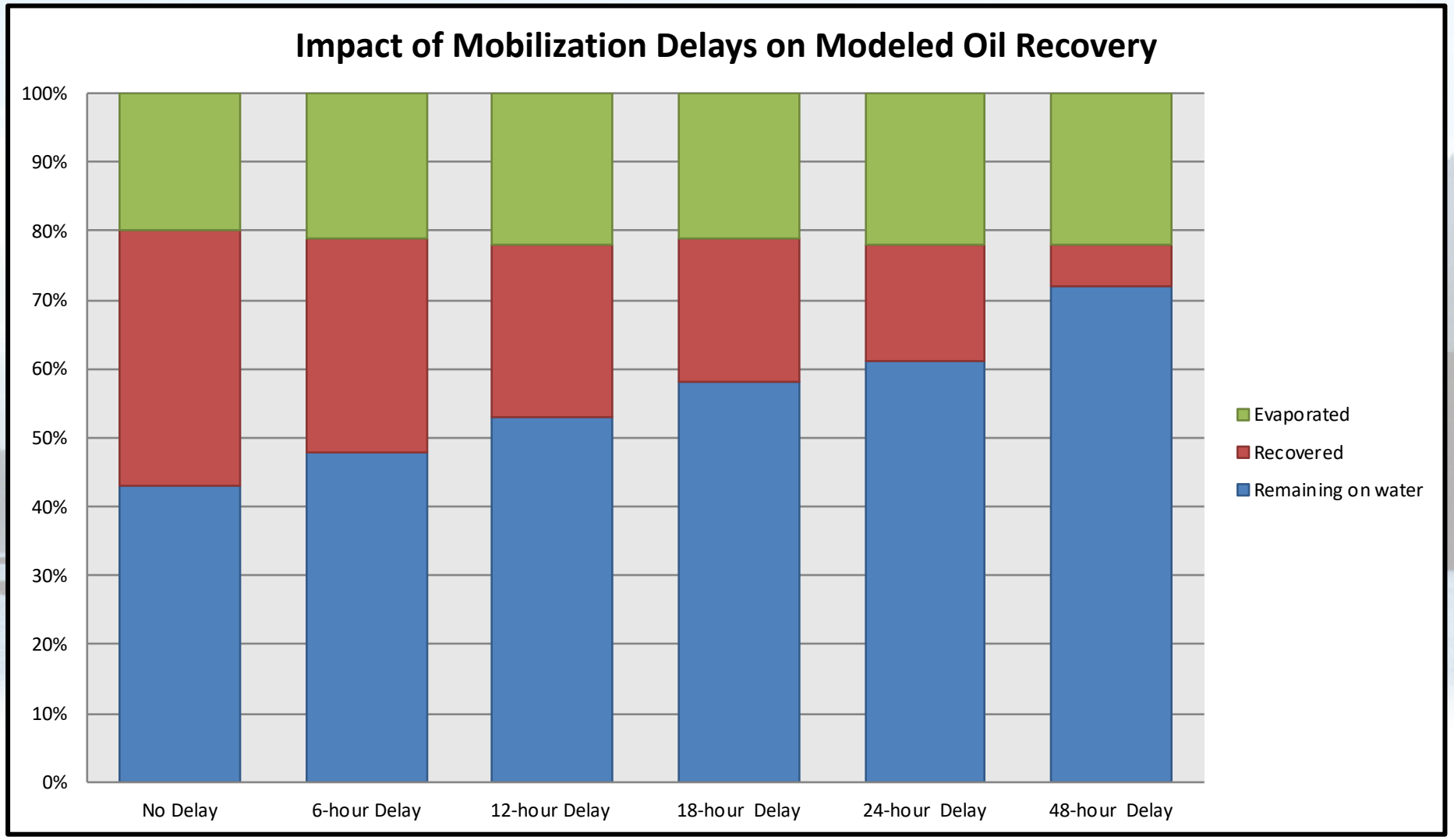
1. Establish research questions
2. Gather information (local conditions, vessel routes, potential spill volumes & product, response forces)
3. Establish base case & additional scenarios to answer research questions using information gathered
4. Run ROC
5. Run additional calculations as needed (secondary storage volumes, queueing, etc.) for base case and additional scenarios
6. Interpret and present results

Establishing Research Questions

For example if we asked the research question: "*How does a delay in response affect response capacity?*"

If the Base Case scenario was run with a one hour delay prior to mobilization, we might run scenarios with a 2, 4, 6, 12, and 24 hour delay to see how the response capacity changes.

Example Output

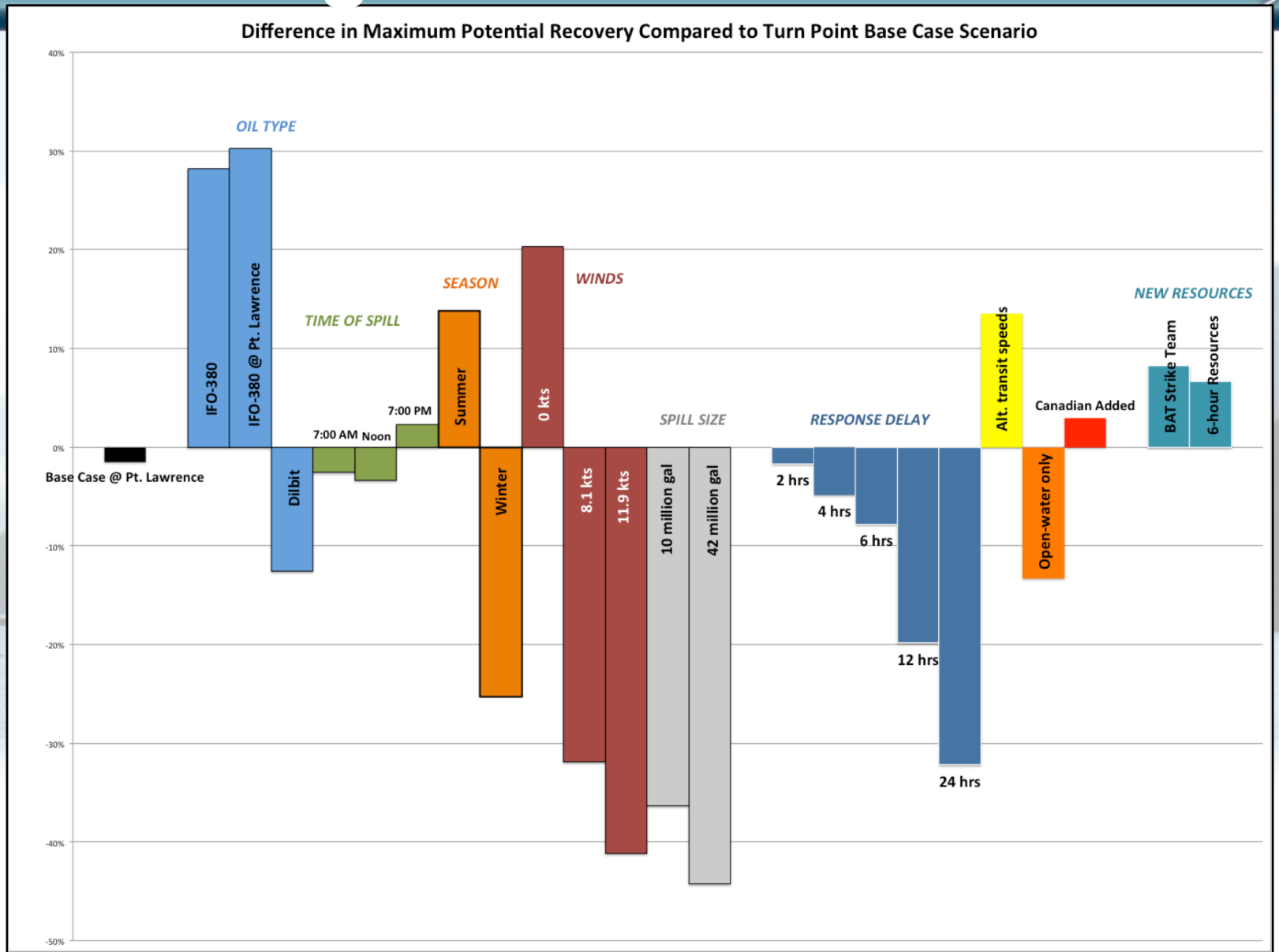


Use of Scenarios

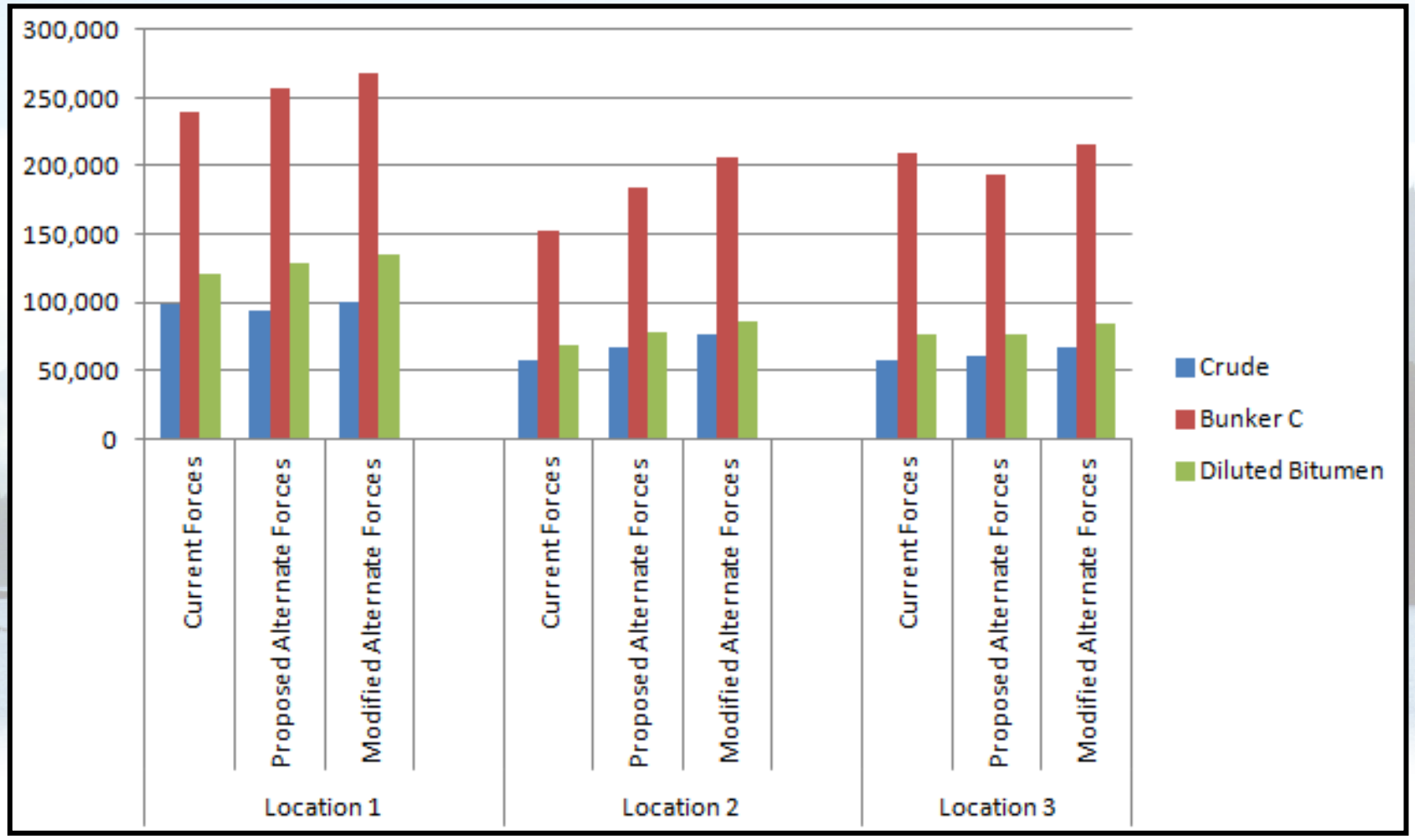
To answer each research question we will establish the inputs for a number of scenarios to run and then compare those scenarios to the base case and to each other.

Ultimately all scenarios can be compared to the base case to see the relative changes.

Example Comparison of Scenario Results Against Base Case



Another Example Output



Grays Harbor Response Capacity Analysis

Establishing Research Questions

- Questions should be geared towards what you want to know, not just what you can ask
- HOWEVER, we can only answer questions that fit within the confines of ROC + some limited additional calculations
- Examples given here are drawn from
  - Workshop summary from May
  - Understanding that there is interest in following similar approach to San Juan County study

Possible Research Questions

- What is the maximum potential capacity for a spill response in Grays Harbor? [Base Case?]

Typically use favorable conditions here.

[Refer to handout for parameters.]

Research Questions – Spill Context

1. How does spill location affect response capacity? (3 locations identified - one will be base case)
2. How much does a change in oil type change response capacity? (IFO-380, diesel, biodiesel, ANS crude*)
3. How does changing spill size affect response capacity?

*for comparison with SJC

Research Questions – Spill Context

4. How does changing wind speed affect recovery capacity? (0 knots, median, 75th percentile - used in San Juan County)

5. How does changing the time of day of the spill affect recovery capacity?

6. How does changing the season affect recovery capacity? (hours of daylight & winds combined)

Research Questions: Response

7. How do response delays affect recovery capacity? *Due to weather or lack of readiness.* (2, 4, 6, 12, and 24 hours delays)

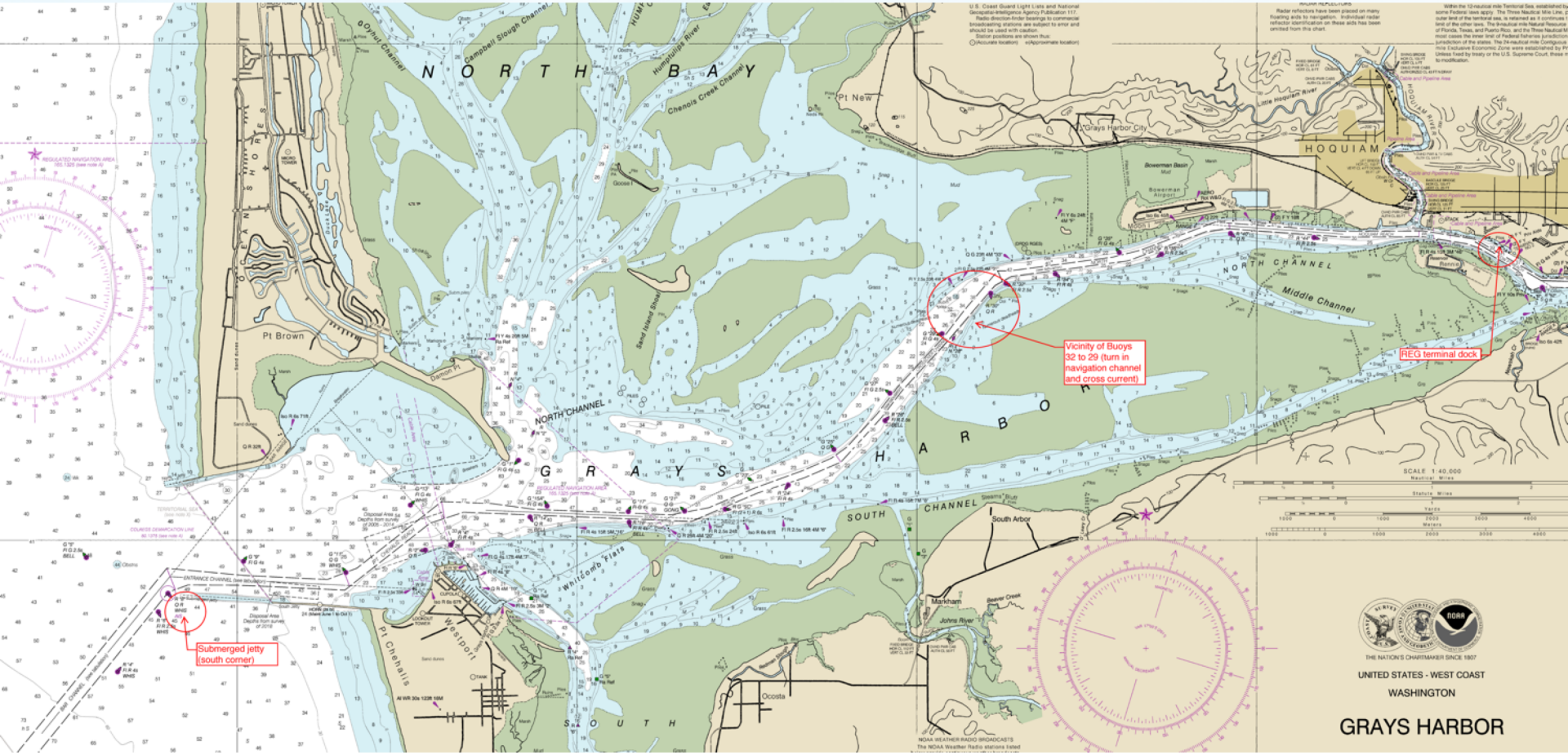
8. What is recovery capacity at the port in conditions that exceed safe & effective thresholds for pre-booming?

9. How might [TBD] enhancements to the response system affect recovery capacity?

Basis for Inputs

- Spill:
  - Product(s) and volumes moved through Grays Harbor
  - Local conditions
  - Location(s) on shipping route
- Response Forces
  - MSRC, NRC, Salvage (type, location, mobilization, transit, deployment, etc.)
  - Nearshore/offshore?

Possible locations

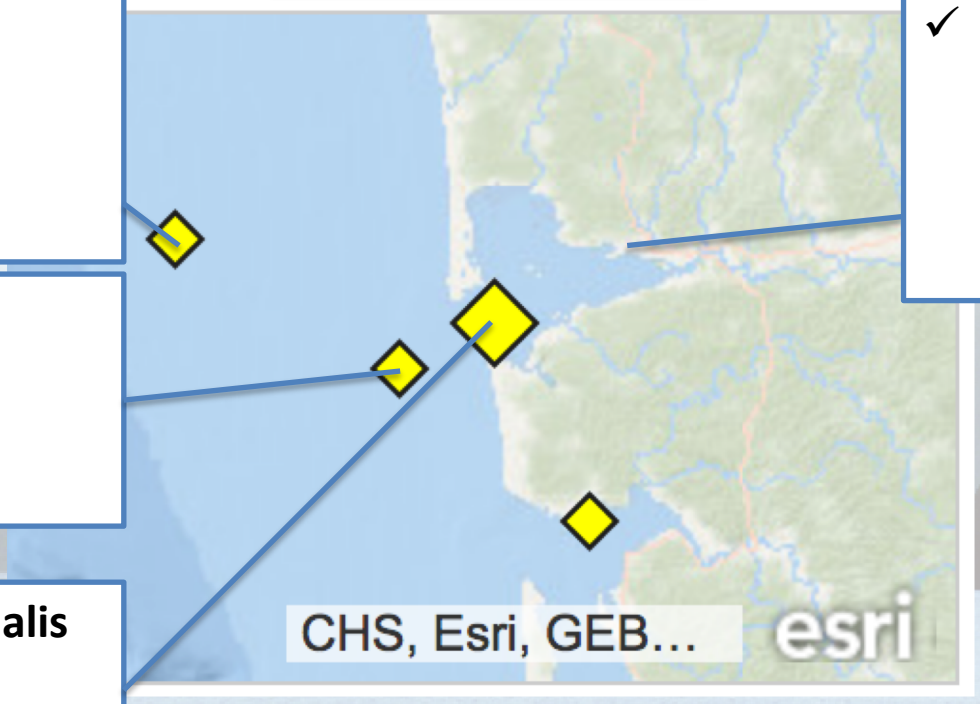


Metocean data sources

Buoy 46099
- ✓ Wind
- ✓ Waves
- X Visibility
- \- (limited years)

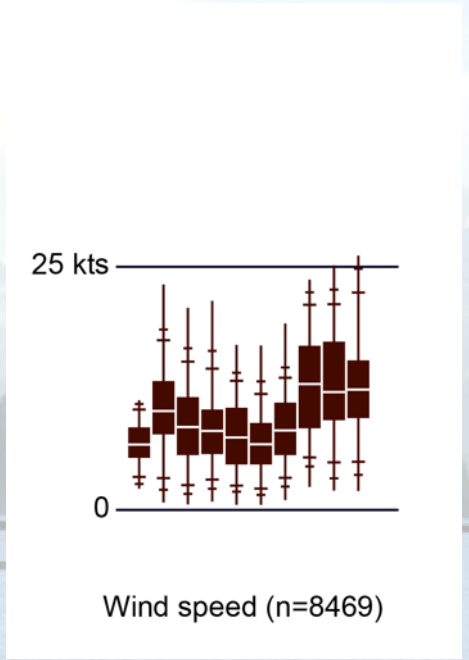
Buoy 46211
- ✓ Waves
- X Wind
- X Visibility

Westport/Pt. Chehalis land station
- ✓ Wind
- X Visibility

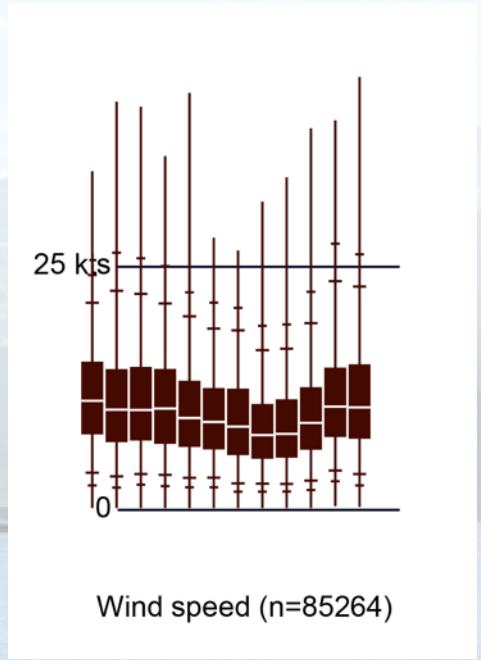


Bowerman Airport
- ✓ Wind
- ✓ Visibility (not run in analysis, but discussed on side and may inform discussion of potential delays)

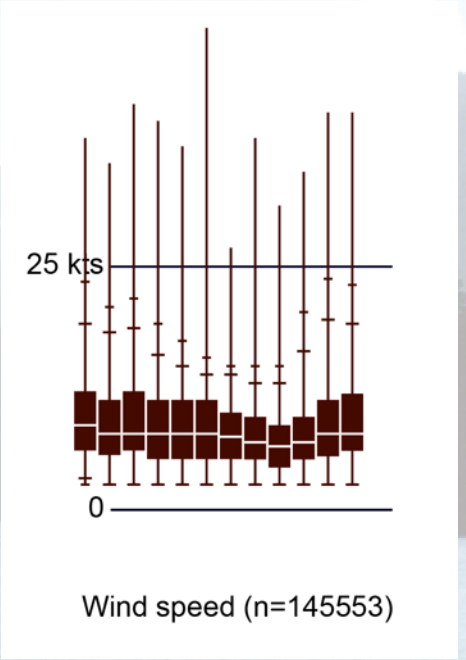
Wind speed – initial workup



Buoy 46099

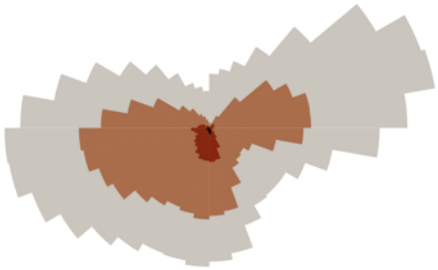


Westport



Bowerman

Bowerman



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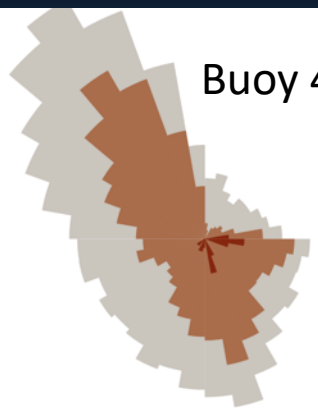

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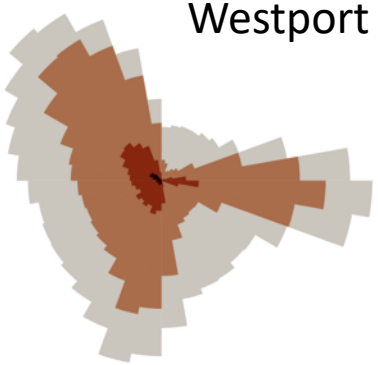
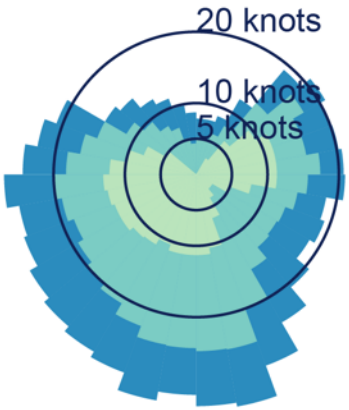
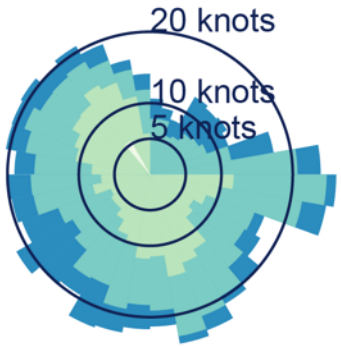
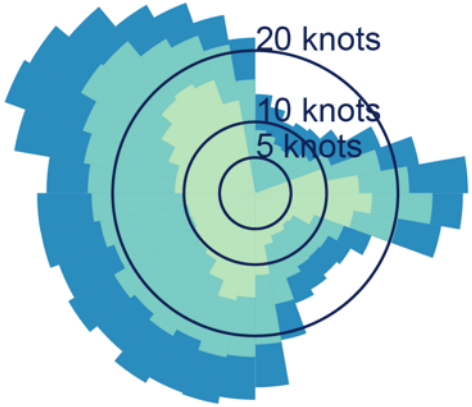


All wind speeds
Winds above 10 knots
Winds above 22 knots
Winds above 34 knots







0.01% of the time
0.1% of the time
1% of the time
10% of the time

Challenges

How do we account for these practical challenges in the context of our RCA analysis?

- Tidal cycle
- Confined area
- Staging areas

Next steps

1. Summary of this meeting
2. Finalize baseline and scenarios
3. Finalize inputs
4. Run analysis
5. Present preliminary results
6. Develop draft and final reports including comments from stakeholders